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(54) TRANSPORTEUR A ACCUMULATION DYNAMIQUE
(54) DYNAMIC ACCUMULATOR CONVEYER SYSTEM

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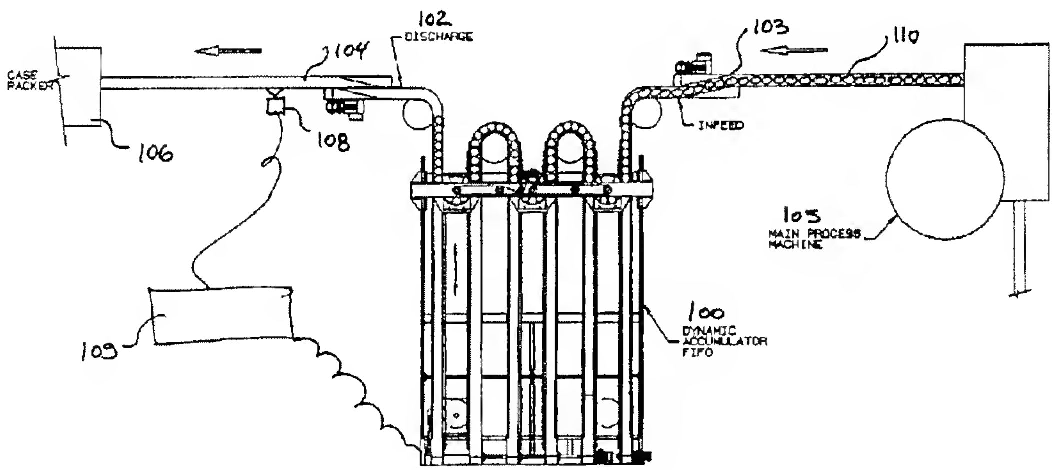

TITLE OF THE INVENTION

[001] DYNAMIC ACCUMULATOR CONVEYER SYSTEM

FIELD OF THE INVENTION

[002] The present invention relates to a dynamic article accumulating conveyer system for providing a variable length buffer zone in a production line. More particularly, the present invention relates to a variable length in-line accumulating system of the fist-in first-out (FIFO) type, providing positive guidance of the articles for optimal stability.

BACKGROUND OF THE INVENTION

[003] In production lines, there is often a need for an accumulating conveyer system to provide a buffer for the temporary storage of articles so as to avoid stopping of the entire line when a downstream machine is down or creates a backflow. Such a system is usually installed downstream a main machine having a lower production rate than the other stations on the line, and therefore constituting a bottle neck. Upon occurrence of a backflow downstream an accumulator, incoming articles from the upstream line section are temporarily stored in the accumulator and eventually released when normal operation resumes. Operation of the slowest machine may thereby be maintained during a downstream article back-up, thus permitting optimal productivity of the production line.

[004] Several accumulator systems have been developed over the years, most of them providing an area where articles accumulate in bulk such as presented in US patent 4,401,207, issued to Garvey in 1983. Accumulators of that type do not comply with the need to prevent shocks between brittle articles and do not provide appropriate stability control as required to positively

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maintain articles with high profile and low base area in a safe upright position. Moreover, such accumulators provide no indication that the articles entering the accumulating zone will come out in the same order, according to a first-in first-out (FIFO) mode. This is a limitation of generally prime importance, as many articles such as food products or sequentially numbered or dated articles for instance, must maintain their positional relationship throughout the production line.

[005] Some other accumulators provide a normally bypassed fixed length in-line conveyer section, possibly equipped with side-railing guides, toward which the flow of articles is directed when accumulation is required. US patent No 4,359,149 (Erlichmann et al. – 1982) presents an example of such an accumulator. Since this type of accumulator relies on passive turnaround guides to pass the articles form a conveyer to an adjacent one, backpressure and shocks are resulting, especially when handling odd-shaped articles. This type of concept also usually not complies with the FIFO approach or requires conveyers to be driven much faster than the production line to compensate for the fixed length of the accumulator, which may create problems with unstable articles. Moreover, such accumulators are rather used as buffers since they are not designed to empty themselves and resume an accumulating function once filled with articles after failure of a downstream station. They are also unable to operate efficiently as recovering units since accumulated articles must travel up to the discharge end of the accumulating conveyer before reaching the main conveyer line. Therefore, the downstream station will generally experience some idling, thus creating a lack of productivity.

[006] Some dynamic variable length accumulators are also known, which accumulate articles on a conveyer operated in a given direction, and discharge said articles back to the production line by operating said conveyer in the opposite direction. Although that type of accumulator efficiently prevents idling of the upstream stations, that concept does not comply with the

requirements for FIFO operation. An example is provided by patent No US 6,298,971 issued to Belz et al. on October 9, 2001.

[007] Another type of variable length accumulators of the prior art operates on a FIFO basis and deserves interest. As disclosed for instance in US patent No 6,230,874 issued to Steeber et al. on May 15, 2001, the apparatus comprises two parallel conveyers driven in opposite directions and a movable transport member disposed across and movable along a space between the conveyers. The transport member is provided with an article transfer device adapted to transfer an article from one conveyer to the other. If a speed difference exists between the two conveyers, the movable member travels along the conveyer longitudinal axis to thereby modify the effective length of the article accumulation zone, as an automatic reaction to a slowdown of the downstream flow of articles.

[008] Despite the interest of that concept, it still presents the major shortcoming of not providing the possibility of installing a guide railing on both sides of each conveyer in order to ensure positive control of unstable articles. Also, since the speed of the article transfer device is hardware defined as a fixed ratio of the conveyer speed difference, no flexibility is provided to vary the transfer speed or the relative conveyer speeds in order to adjust the spacing between articles, and thereby provide optimal control of backpressure, slippage and shocks, especially to adapt to different shapes of articles.

[009] It is also worth mentioning a variable length horizontal accumulator disclosed in US patent No 4,413,724, by Fellner and issued on November 8, 1983. In one embodiment of that invention, deployable side railings are provided along an expendable conveyer section. However, the deployable railing system is complex and no control is provided to properly manage spacing between articles, especially in curved paths. Indeed, a flow of adjacent articles with non-circular base tends to expand in curved paths;

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system jam or damage to articles may occur if sufficient slippage is not allowed or the resulting backpressure is too high. Proper dynamic control of the spacing between articles is therefore required to prevent such problems.

[010] Although the above examples show that many accumulating conveyer systems exist, these accumulators are nevertheless lacking important features necessary for them to perform properly when dealing with unstable high profile articles. Also, no practical solution is provided in the prior art for the control of the spacing between articles as needed to properly handle locking, backpressure, slippage and shocks, especially when transporting odd shape and/or brittle articles.

[011] There is thus a need for a FIFO dynamic accumulator conveyer providing variable length buffer zone, as well as continuous side railing guidance of the transported articles and control of the spacing thereof, according to preferred structures as contemplated in the present invention.

OBJECTS OF THE INVENTION

[012] An object of the present invention is to provide a modular thermoelectric unit which overcomes the above discussed limitations and drawbacks.

SUMMARY OF THE INVENTION

[013] More specifically, in accordance with the invention as broadly claimed, there is provided a dynamic article accumulator conveyer system for installation within a production line conveyer between an article delivering station and an article receiving station, the accumulator comprising, at least one pair of parallel generally horizontal conveyer runs, adjacent runs being driven in opposite directions, and defining an infeed conveyer section

comprising an infeed end, a discharge conveyer section comprising a discharge end, and an article accumulating section. The infeed end is in article flow communication with an infeed section of the production line conveyer downstream said delivering station, the discharge end being in article flow communication with an outfeed section of the production line conveyer upstream said receiving station. The discharge conveyer section is driven independently from the other sections of the accumulator, so that it may be stopped whenever the flow of articles at the outfeed section of the production line stops.

[014] Conveyer runs of each adjacent pair are bridged by an independently driven transfer disc mechanism, mounted on a transfer carriage suited for mobility along the longitudinal axis of said conveyer runs from a proximal (near production line conveyer) to a distal end thereof, to enable transfer of the articles from one conveyer run to the adjacent one at any point along the longitudinal axis of said conveyer runs, thus dynamically varying the effective length of the accumulation section of the accumulator. The transfer carriage comprises an autonomous drive system which simultaneously and automatically reacts to a variation in the downstream flow of articles at the outfeed section of the production line (ex. stop of receiving station) to move the transfer disk mechanism toward the distal end of the conveyer runs and thereby increase the effective length of the accumulator, thus continuously providing the exact amount of storage capacity required by articles incoming at the infeed end. .A transfer conveyer loop enables the transfer of articles from a given pair of conveyer runs to an adjacent pair.

[015] In accordance with preferred embodiments:

[016] – the parallel conveyer runs are mainly comprised of substantially rectilinear portions;

[017] – two guide railings are automatically deployed between adjacent conveyers following the displacement of each mobile transfer disc mechanism by the transfer carriage, to provide guide railing on both sides of every conveyer run portion loaded with articles;

[018] – all conveyer runs comprise an adjustable rail on the opposite side to the automatically deployable guide railing, so to provide adjustment of the conveyer width to adapt to the width of the transported articles and maintain the orientation of odd shape articles.

[019] – the article accumulating section of the dynamic accumulator conveyer comprises at least one U shape horizontal conveyer, comprised of two parallel linear conveyer runs driven in opposite directions and connected by a radial transfer conveyer loop at their proximal end, located between and adjacent to the infeed conveyer section and the discharge conveyer section;

[020] – the dynamic accumulator conveyer comprises two adjacent U shape horizontal conveyers located parallel and between the infeed conveyer section and the discharge conveyer section, and two transfer disc mechanism mounted on the transfer carriage;

[021] – the transfer disc mechanisms are driven by a common independent drive so that the rotation speed thereof can be adjusted independently from the speed of the conveyer runs of the accumulator;

[022] – the transfer carriage is provided with its own drive so that the travelling speed of said carriage and associated transfer disc mechanisms and deployable guide railings can be modified at will independently from the speed of the conveyer runs of the accumulator;

[023] – the infeed end is part of an infeed conveyer run driven separately from the U-shape parallel conveyer(s) of the accumulating section, to enable driving it at the same speed or at a different speed.

[024] – the U shape conveyers are connected together at their distal end by a radial transfer loop to form a continuous serpentine conveyer run;

[025] – when accumulation of articles is being carried out, the speed of the U shape conveyers is half the speed of the infeed conveyer;

[026] – when the accumulator is discharging articles, the speed of the U shape conveyers is 100% of the speed of the infeed conveyer and the speed of the discharge conveyer is 125% of the speed of the infeed conveyer.

[027] The present invention also relates to a multistage dynamic accumulator conveyer comprising at least two dynamic accumulator conveyers as described in the foregoing, being located at different vertical levels and serially connected by a sloped conveyer portion, in order to enable the transfer of articles from a vertical level to another.

[028] The foregoing and other objects, advantages and features of the present invention will become more apparent upon reading of the following non restrictive description of preferred embodiments thereof, given for the purpose of illustration only with reference to the accompanying drawings:

BRIEF DESCRIPTION OF THE DRAWINGS

[029] In the appended drawings:

[030] Figure 1 is a schematic plan view of a preferred embodiment of the dynamic accumulator conveyer of the present invention implemented into a production line;

[031] Figure 2 is a plan view of a preferred embodiment of a dynamic accumulator conveyer of the present invention using two central conveyer loops;

[032] Figure 3a is a side elevation view of the dynamic accumulator conveyer of Figure 2;

[033] Figure 3b is a partial front elevation view of a transfer disc system of the dynamic accumulator conveyer of the present invention;

[034] Figure 3c is a partial front elevation view of a deployable guide railing system of the dynamic accumulator conveyer according to the present invention;

[035] Figure 4 is a plan view of a transfer disc system co-operating with chain conveyers in the dynamic accumulator conveyer according to the present invention;

[036] Figure 5a is a front elevation view of a deployable guide railing system of the dynamic accumulator conveyer according to the present invention;

[037] Figure 5b is a cross sectional side view of front elevation view of a deployable guide railing system of Figure 4a, as seen about line A – A;

[038] Figure 5c is a cross sectional side view of front elevation view of the deployable guide railing system of Figure 4a, as seen about line B - B;

[039] Figure 6 is an enlarged cross sectional view of a deployable guide railing system of Figure 5c;

[040] Figure 7a is a top view of a dual stage dynamic accumulator conveyer according to a further embodiment of the present invention, using one central conveyer loop per stage; and

[041] Figure 7b is a front elevation view of the dual stage dynamic accumulator conveyer of Figure 7a;

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[042] Similar parts in the various figures of the appended drawings are identified by the same reference numerals.

[043] Preferred embodiments of the dynamic accumulator conveyer according to the present invention will now be described in detail with reference to the appended drawings.

[044] Referring to Figure 1, there is illustrated a dynamic accumulator conveyer generally identified by the reference 100, implemented into a production line comprising an infeed conveyer 103 downstream a delivering station 105 and an outfeed conveyer 104 upstream a receiving station 106. The accumulator comprises an infeed end 101 and a discharge end 102. In a typical application of the accumulator 100, the delivering station 105 is a main process machine such as a filler in a bottle filling line, being the slower paced machine on the line. The receiving station 106 is generally a faster paced machine such as a case packer. In such a situation, the accumulator 100 receives the articles 110 from the infeed conveyer 103 at its infeed end 101 at a speed of 100% and delivers the articles 110 to the outfeed conveyer 104 at its discharge end 102 at a speed in the order of 125%.

[045] As will be described in the detailed description hereinafter, in the event of a failure of the receiving station 106 and a consequent stop of the flow of articles 110 at the discharge end 102, the accumulator 100 starts accumulating articles 110 incoming at infeed end 101 to enable the main process machine 105 to remain operational and thereby preserve the productivity of the production line. Whenever the receiving station 106 resumes normal operation, the accumulator starts discharging articles 110 at 125% of infeed speed at discharge end 102 to outfeed conveyer 104, and eventually empties itself to be ready for a new accumulation cycle. The functions of the dynamic accumulator conveyer system are controlled by a programmable controller 109, having outputs connected to numerous drives and inputs connected to sensors such as the proximity sensor 108 monitoring the flow of articles on outfeed conveyer 104 of the production line.

[046] Alternatively, the accumulator 100 can be installed upstream a main process machine to provide a dynamic recovery unit. In such a case, in the event of a failure of the main process machine, the production of the upstream machines that can not be stopped can be temporarily stored into the accumulator.

[047] In a still different mode of operation, the accumulator can be operated while remaining partly filled with articles, so that downstream stations such as the main process machine, may remain in operation while an upstream station is stopped since the accumulator keeps on delivering articles until the stopped machine resumes normal operation and refills the accumulator to a predetermined level. Productivity is thereby gained since interruptions of the main process machine are prevented.

[048] Referring now to Figure 2, there is illustrated a dynamic accumulator conveyer 100 according to a preferred embodiment of the present invention, receiving articles 110 at an infeed end 101 and delivering

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articles 110 at discharge end 102. The accumulator 100 further comprises rectilinear infeed conveyer 1 driven by motor drive 11 in the direction of arrow 14 and discharge conveyer 2 driven by motor drive 13 in the opposite direction as indicated by arrow 15. Two U shape conveyers respectively constituted by linear parallel conveyer runs 3 and 5 connected by radial conveyer segment 4, and linear parallel conveyer runs 6 and 8 connected by radial conveyer segment 7, are inserted between said infeed conveyer 1 and discharge conveyer 2 and adjacent thereto. It should be mentioned that in a minimal embodiment of the invention, U shaped conveyers could be omitted. Also, one, two or more of such U shape conveyers can be incorporated into the accumulator 100, according to the required storage capacity.

[049] Adjacent linear conveyer runs 3,5,6 and 8 of U shape conveyers are driven in opposite directions by a single motor drive 12 through drive shaft 16. Radial conveyer segments 4 and 7 are formed by a flexible chain run deflected by fixed pulleys 9 and 10 respectively. Therefore, one can easily appreciate that all conveyer runs of U shape conveyers are driven at the same speed, while the infeed conveyer 1 and the discharge conveyer can be driven at different speeds.

[050] The accumulator 100 further comprises a travelling transfer carriage 17, suited for travelling on ball slides 25 and 26 along the linear conveyer runs from a proximal end (as shown) to a distal end thereof and back, as indicated by arrows 18. Carriage 17 carries three transfer disc mechanisms 19, 20, and 21 for respectively transferring articles 110 from conveyer run 1 to 3, 5 to 6 and 8 to 2 respectively. All transfer disc mechanisms are driven in the same direction (clockwise as represented) by a common motor drive 22, through belt 23 and a series of pulleys such as 24, independently from any conveyer drive. Figure 4 presents an enlarged view of a transfer disc mechanism 19, for transferring articles 110 (not shown) from conveyer 1 to conveyer run 3. The transfer disk mechanism 19 comprises a

rotary disc 27, the top face thereof being located at the same horizontal level as the top conveyer runs 1 and 3, an external article deflecting rail 28 and an internal article deflecting rail 37 defining a semi-circular path from conveyer run 1 to conveyer run 3. As better seen from Figure 3b, disc 27 is driven through a drive shaft 29 rotating in ball bearings 31 and 32 into a guiding tubular sleeve 30, the top end of said shaft 29 being assembled to a drive pulley 24 driven by belt 23 through motor drive 22. Ball bearing 32 and tubular sleeve 30 are rigidly assembled to the frame 33 of transfer carriage 17.

[051] Figure 4 also represents a deployable guide railing assembly comprising a pair of roller chains 34 on which connecting plates such as 35 are assembled, said assembly being connected to the transfer disc mechanism 19 and in turn to the carriage 17 through a fixed part of mechanism 19 such as the internal deflecting rail 37. As can be seen form Figures 5a and 5b, the three pairs of chains 34 run on fixed rails such as 41 (see Figure 6) and their lower runs are connected through sprockets such as 42 to a common drive shaft 38 being driven by a motor drive 36. Also from Figure 6, it can be observed that a pair guide rails 39a, b is adjustably assembled on each guide rail connecting plate 35 using a pair of torque knobs and bolts 40a,b. Therefore, as seen from Figure 5a, and 5b, activation of drive 36 puts chains 34 in synchronous motion, in turn causing transfer disc mechanisms 19, 20 and 21 mounted on sliding transfer carriage 17 to travel between parallel conveyer runs, with the guide railings 39 a, b continuously deploying behind. Since laterally adjustable side rails 43a and 43b are fixedly assembled to the external walls 44a, b of the three conveyer guiding frames 44, the conveyer runs upstream of the transfer discs (proximal end of accumulator 100) is provided with a side guiding rail on both sides thereof, thereby ensuring full lateral support and guidance of articles 110. Lateral position of guide rails 39 and 43 is adjusted according to the shape and size of articles 110, and flow control may also be effected by adjusting said position of the guide rails to provide a certain level of friction with said articles.

[052] Referring again to Figures 1 and 2, in operation, the dynamic accumulator conveyer 100 receives articles 110 from a delivering station 105 at its infeed end 101 on infeed conveyer 1 ran at 100% of the speed of infeed conveyer 103. Said articles are being transferred to conveyer run 3 by transfer disc mechanism 19 pass on to conveyer run 5 through radial path 4, are transferred again by transfer disc mechanism 20 to conveyer run 6, pass to conveyer run 8 through radial path 7, and are finally transferred by transfer disc mechanism 21 to discharge conveyer 2 and transported across the discharge end 102 top the outfeed conveyer 104 toward the receiving station 106. In such a normal operation, unless a change in the spacing between the articles 110 is performed by an acceleration or deceleration at infeed end 101, all of the conveyers are being ran at the same linear speed as the infeed conveyer 103, except the discharge conveyer that is ran approximately 25% faster. The transfer disc mechanisms19, 20 and 21 are also driven at a same speed, adjusted according to whether a change in article spacing is required or not.

[053] Should the flow of articles 110 on outfeed conveyer 104 be interrupted , as detected by proximity detector 108 and controller 109, said controller commands discharge conveyer 2 to stop while it energizes motor drive 36 to put transfer carriage 17 in motion toward the distal end of the accumulator, at 1/6 of the infeed conveyer speed (1/4 in the case of an accumulator with 4 parallel conveyer runs). Indeed, to add one incoming article in accumulation, the effective length of each conveyer run must increased by a distance of L/n per unit of time, n being the number of parallel conveyer runs, and L being the length of the base of the article 110 Simultaneously, controller 109 sets the linear speed of accumulating conveyer runs (U shape conveyers) to 50% of that of incoming conveyer 1 to avoid backpressure and limit slippage of the articles on the conveyers. Therefore, articles 110 are being stored in the dynamic accumulator 100.

[054] Whenever normal operation of the downstream receiving station 106 resumes, causing the flow of articles detected by proximity sensor 108 to be re-established at 125% of the infeed speed, controller 109 reactivates discharge conveyer 2 to a speed of 125%. Simultaneously, all of the other conveyers are being driven at 100% of the infeed speed and the carriage 17 is caused to start traveling in the direction of the proximal end of the accumulator, but always at the same speed. A gradual net discharge of the accumulator is therefore initiated and sustained until the carriage return to its original position. The accumulator is then ready to repeat a new cycle.

[055] Turning now to Figures 7a and 7b, there is illustrated an alternative embodiment of a dynamic accumulator conveyer according to the present invention. The illustrated dual stage dynamic accumulator conveyer comprises two dynamic accumulator conveyers 100 and 100' (with one U shape accumulating conveyer portion) as described in the foregoing, being located at different vertical levels and serially connected by a sloped conveyer portion 107, in order to enable the transfer of articles from a vertical level to another. The sloped conveyer portion connects the outfeed end 102 of accumulator 100 to the inlet end 101' of accumulator 100', and comprises a first linear sloped segment 107a, a substantially horizontal segment 107b and a second linear conveyer segment 107c. As one can easily appreciate, more than two accumulators such as 100 and 100' can be assembled and connected as described hereinabove to form a multistage dynamic accumulator conveyer system.

[056] One can easily appreciate that the above described embodiments of the present invention provide an effective solution for the controlled accumulation of articles on a production line. Particularly, the accumulator provides safe and reliable accumulation of article of a broad

range of shapes, which, along with improved control features, brings unmatched functional performance.

[057] Therefore, it can be seen that the dynamic accumulator conveyer according to the present invention can be advantageously used in applications with numerous advantages over the solutions of the prior art. For example, brittle or unstable articles can be handled safely and efficiently.

[058] The dynamic accumulator conveyer according to the present invention presents, amongst others, the following advantages:

[059] – the dynamic accumulator conveyer provides accumulation of the transported articles according to a first-in first-out principle, thus enabling use with articles requiring to be maintained in a sequential order throughout a process;

[060] – the dynamic accumulator conveyer provides automatic adjustment of the length of the accumulation zone as a function of the instant storage capacity required, thus avoiding excessive dwell time during normal operation of the production line;

[061] – the dynamic accumulator conveyer is generally horizontal so that unstable articles are prevented from tilting or falling down as it may happen in sloped conveyer sections;

[062] – the dynamic accumulator conveyer comprises automatically deployable guide railing to ensure that articles of various sizes and shapes can be maintained in a constant orientation and in a stable and safe position at all time;

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[063] – the dynamic accumulator conveyer provides full control of the back-line pressure and spacing between articles;

[064] – the dynamic accumulator conveyer provides full accessibility of the articles throughout the accumulation zone;

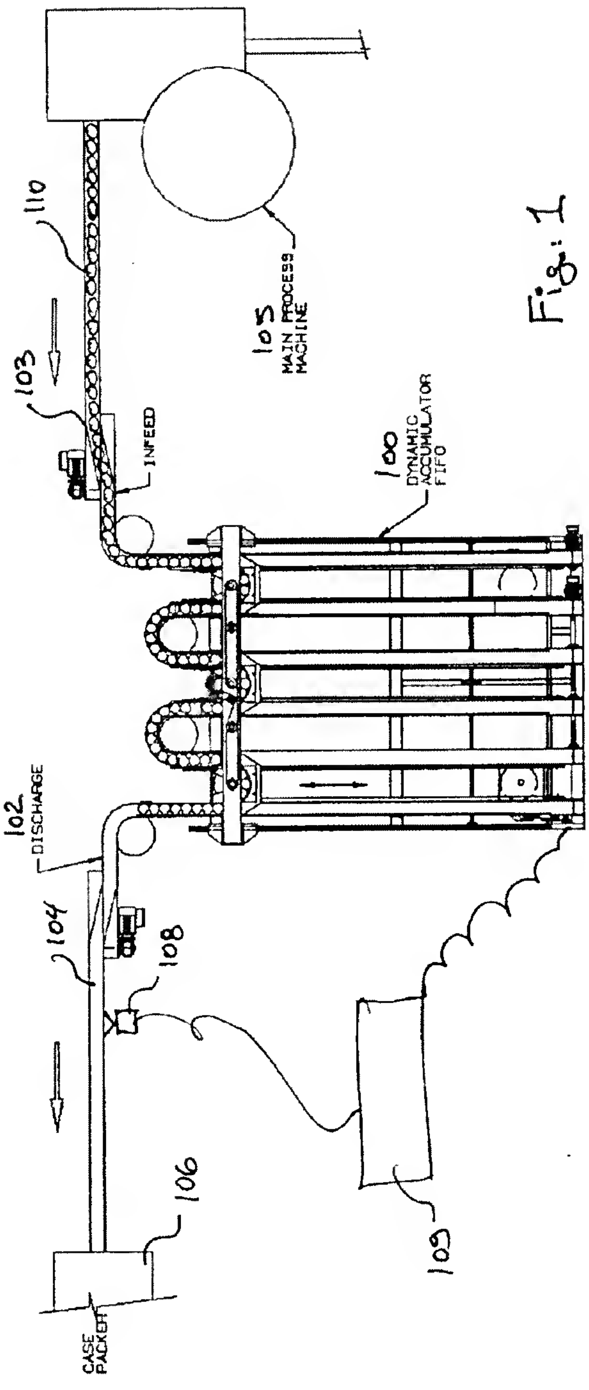
[065] – the dynamic accumulator conveyer needs no spacing to be maintained between articles so that higher yield of the installed conveyer length is obtained;

[066] – the dynamic accumulator conveyer can be used as a dynamic recovering unit, to keep feeding a main station when a machine upstream the accumulator stops;

[067] – the dynamic accumulator conveyer performs accumulation at the same speed as the main production line, thus limiting the risks inherent to faster transport of certain articles; and

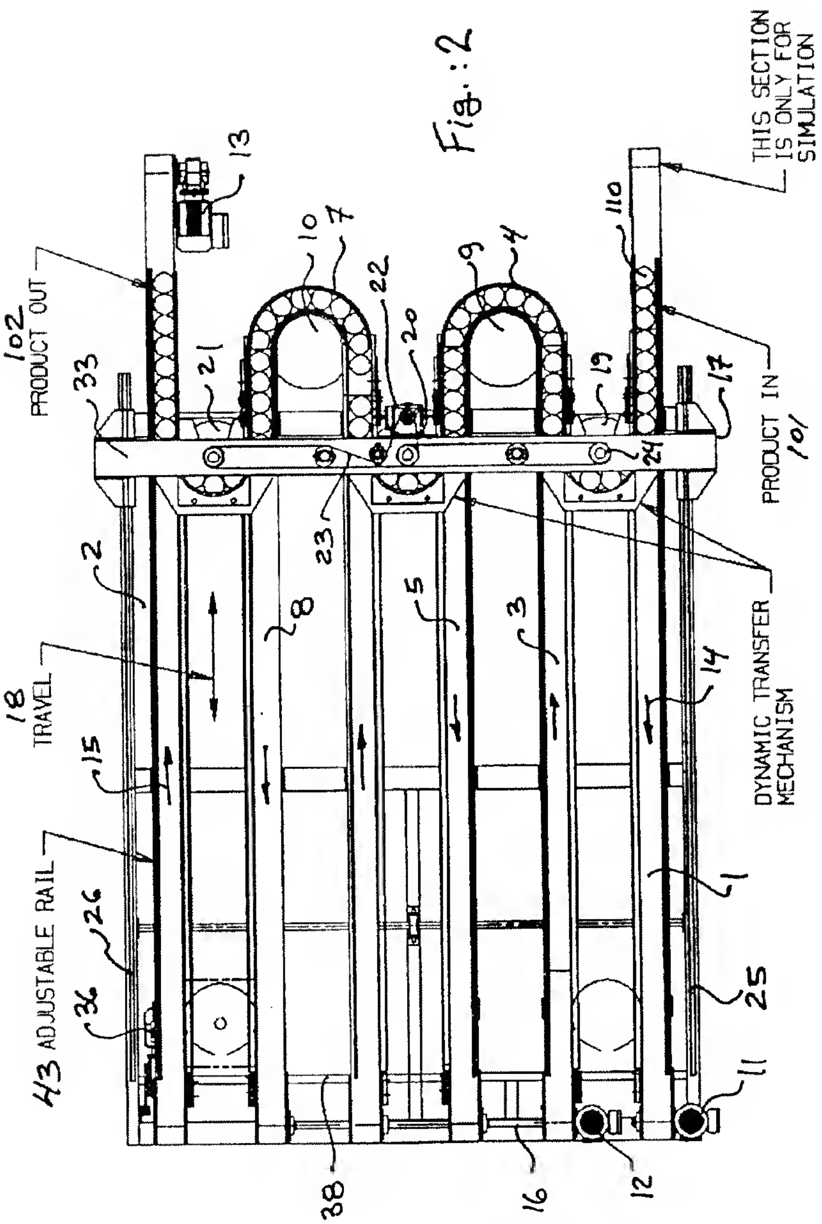
[068] – the dynamic accumulator conveyer provides efficient use of floor space and can be installed in a multi stage arrangement to use free vertical space.

[069] Although the present invention has been described by means of preferred embodiments thereof, it is contemplated that various modifications may be made thereto without departing from the spirit and scope of the present invention. Accordingly, it is intended that the embodiment described be considered only as illustrative of the present invention and that the scope thereof should not be limited thereto but be determined by reference to the claims hereinafter provided and their equivalents.



110
103
INFEED
105
MAIN PROCESS MACHINE
100
DYNAMIC ACCUMULATOR FIFO
102
DISCHARGE
104
108
106
CASE PACKER
109

Fig. 1


102
PRODUCT OUT
18
TRAVEL
43 ADJUSTABLE RAIL
DYNAMIC TRANSFER MECHANISM
PRODUCT IN
101
THIS SECTION IS ONLY FOR SIMULATION
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110

Fig.:2

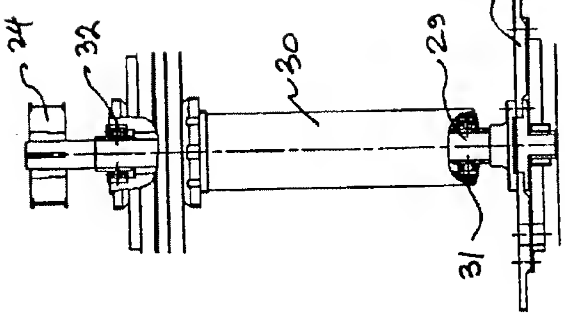


Fig. 3b

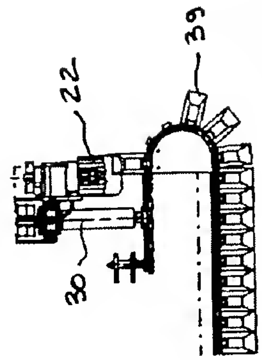


Fig. 3c

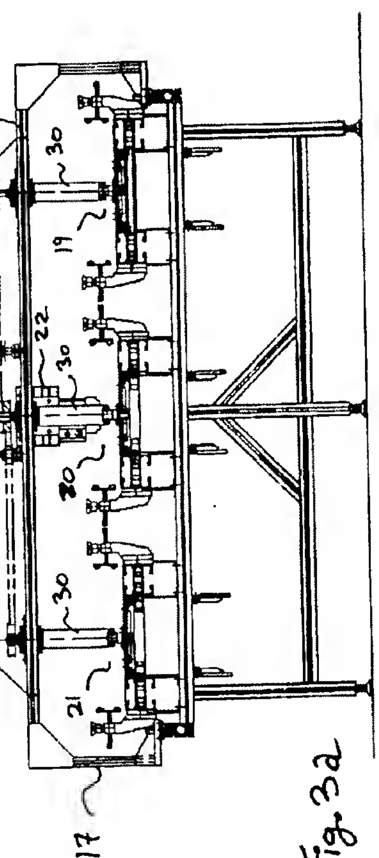
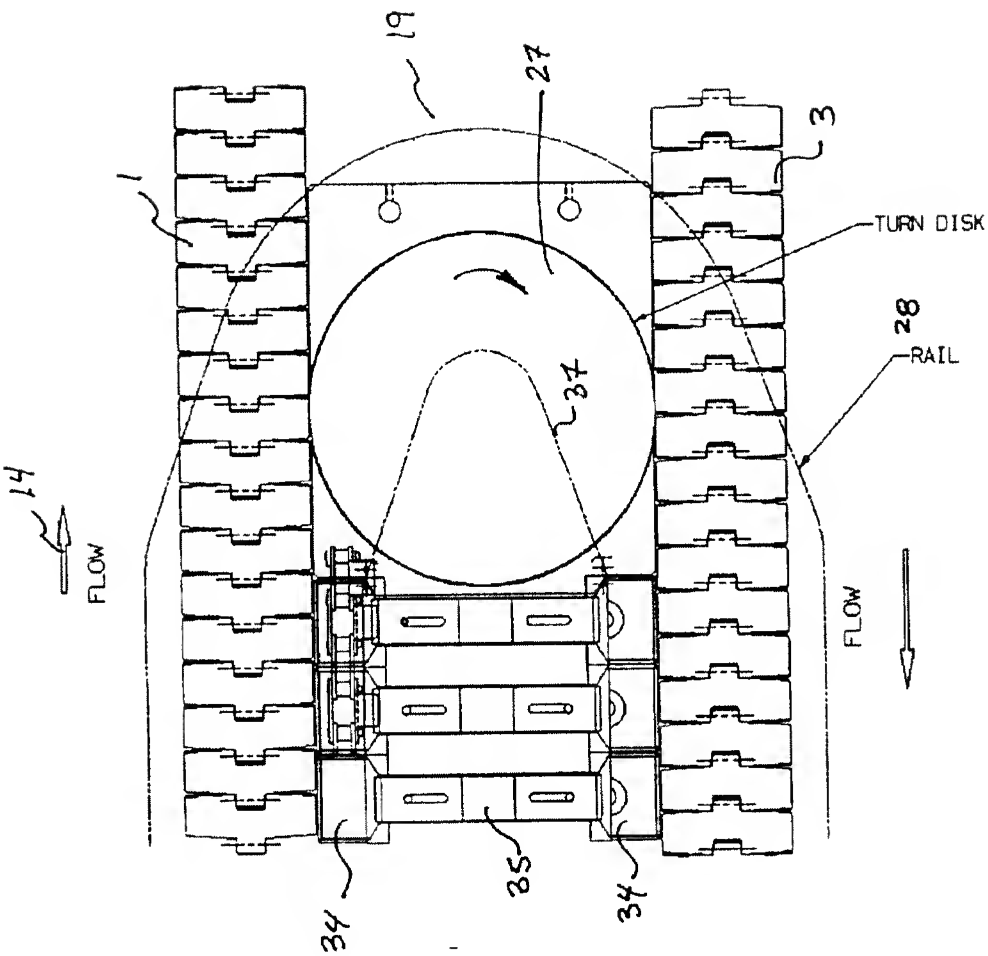
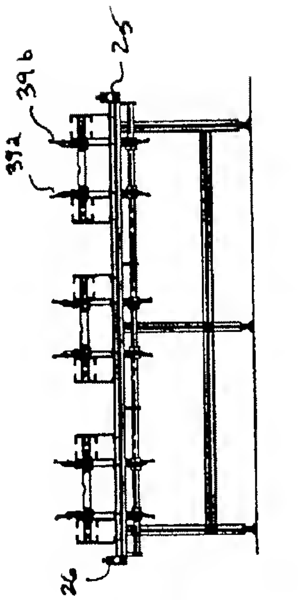


Fig. 3a

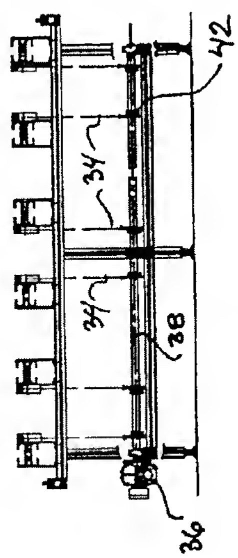
Fig. A





SECTION 'B' - 'B'

Fig. 5c



SECTION 'A' - 'A'

Fig. 5b

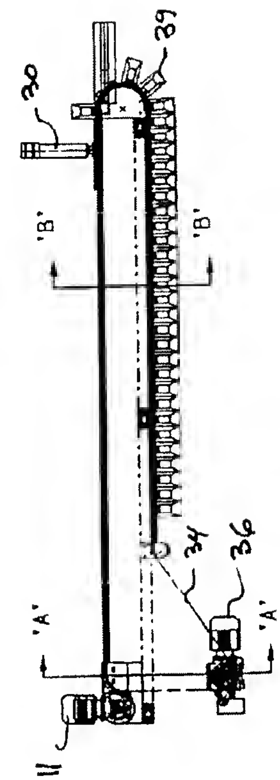
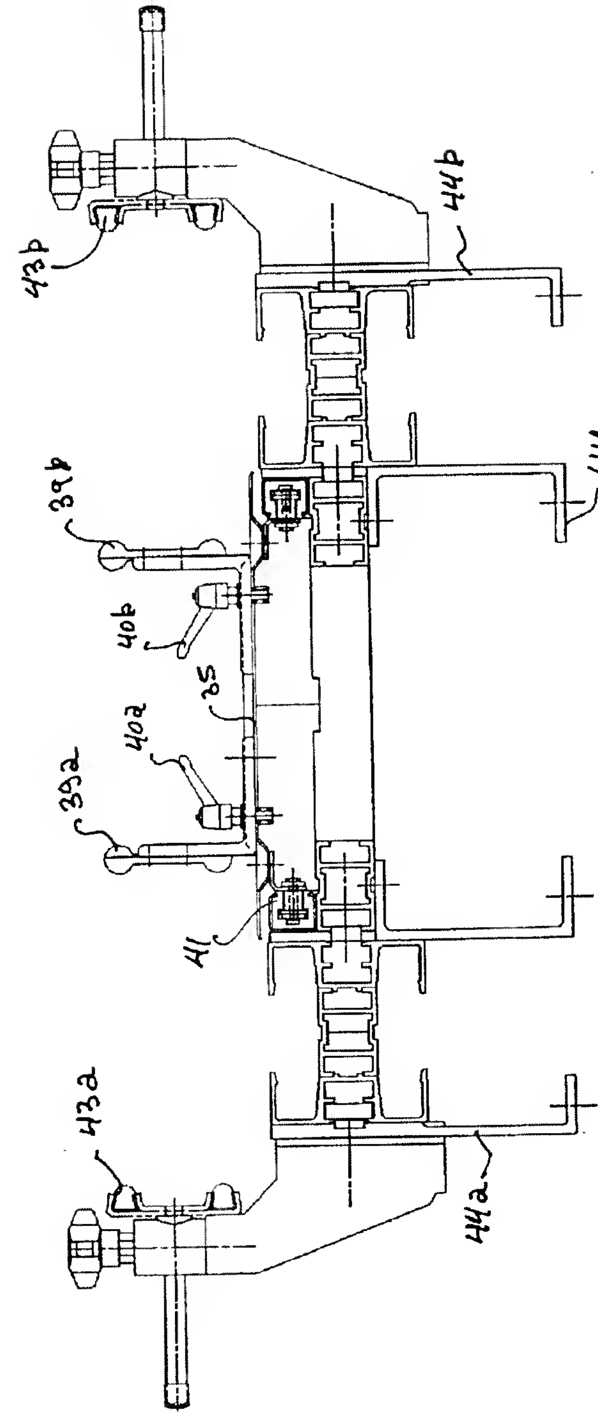


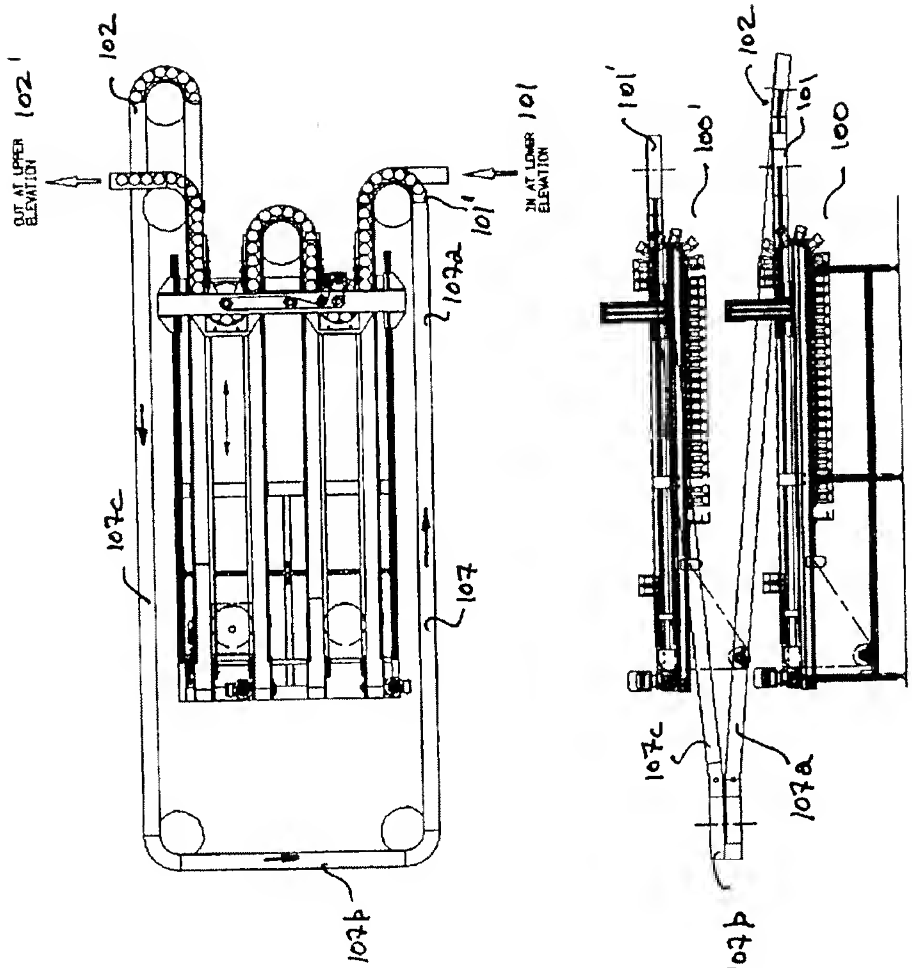
Fig. 5a



SECTIONAL VIEW
OF DEPLOYABLE GUIDES

Fig. 6

Fig. 7



OUT AT UPPER ELEVATION
IN AT LOWER ELEVATION
102'
102
101
101'
107a
107c
107
107b
100
100'

Application number/ Numéro de demande : 2364216

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